z – ph-REM: A PHOTOMETRIC REDSHIFT CODE FOR THE REM TELESCOPE

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Abstract The REM telescope is being deployed these very days at the La Silla Observatory in Chile, and will be fully operational by the beginning of 2004. It is a very fast-slewing robotized telescope, endowed with optical and near-infrared capabilities, designed with the primary objective of performing rapid follow-up of GRB events. One of the key issues will be the prompt recognition of potentially interesting bursts (those happening at high redshift or peculiarly reddened). Here I present a sketch of z-ph-REM, the photometric redshift code designed for this mission.

1. The GRB enigma

One of the major questions still under discussion about Gamma-Ray Bursts is the fact that a large fraction (as high as 50%) of them remains undetected in the optical, even though facilities now exist to perform rapid, multi-site follow-up of the events. Amongst the possible explanations for this observational fact, the most promising ones assume it is the result of major reddening of the source by large quantities of dust, or that the GRB sources lie at such high redshift that the Lyman-α (plus Lyman-limit) absorption by the IGM completely quenches all observed-frame visible light. This would imply GRB redshifts $z \approx 8$ and above.

2. The Swift mission

Swift is a US/Italy/UK mission to be launched on 1/2004, devoted to the detection of GRBs–an estimated 300 events/yr. Swift includes an on-board suite of three telescopes, including γ-rays, X-rays, and optical/UV detectors. Once a GRB will be detected, a prealert signal shall be sent to the control system, and the other telescopes will point to the observed source in order to obtain an accurate position and photometry within seconds. The information will be relayed to all linked stations.

3. The REM telescope

As has just been explained, Swift will cover most of the high-energy spectrum of the observed targets (from ≈ 6000 Å, almost all the way to γ-rays). Unfortunately, it is known that in many cases the optical-UV telescope will show no detection. REM is a fully robotic, 60-cm, fast-slewing, optical-near IR telescope designed to act in parallel with Swift (but also with any other γ-ray observatory) as another optical-infrared eye, able to point to the target position in seconds. Our main objective is the detection and characterization of those GRBs which show no optical counterpart, but could show as bright sources in the near infrared range. A collaborative agreement has been signed with ESO in order to use the REM data as trigger for the observation of such very high-redshift candidates with larger telescopes (VLT).

4. Photometric redshifts

The use of photometric redshift techniques has imposed over the last years as a valid means for measuring redshifts in the case of: (i) many objects, (ii) faint objects, and/or (iii) need for rapid, reasonably approximate results. In the case of the REM targets we will use photometric redshifts in order to estimate the redshift of the observed counterpart. Our code must autonomously and iteratively decide whether more data are necessary, interact with the REM control software, and send out a high-redshift candidate trigger signal as soon as the data quality reaches the pre-defined values for a potentially high-redshift counterpart.

The basis of the photometric redshift code is described in Lanzetta, Yahil & Fernández-Soto (1996, Nature, 386, 751); Fernández-Soto, Lanzetta & Yahil (1999, ApJ, 513, 34); and Fernández-Soto et al. (2002, MNRAS,330, 889). It is based on a likelihood analysis that compares the observed fluxes to the fluxes that would be measured from a series of fiducial spectra. Our technique outputs a redshift probability function using which the quality of the best-fit redshift value can be assessed.

One key difference between $z-ph$-REM and the codes described in the references above is the choice of the comparison templates: $z-ph$-REM will use a series of pure power-law spectra. The power-law colours are preserved when the spectrum is redshifted, thus the only detectable feature will be the one imposed by the IGM absorption. The available selection of filters covers the whole range from 0.4 to 2.5 microns almost continuously, making it possible to characterise GRB counterparts over the redshift range $z \approx 2$ to $z \approx 15$.